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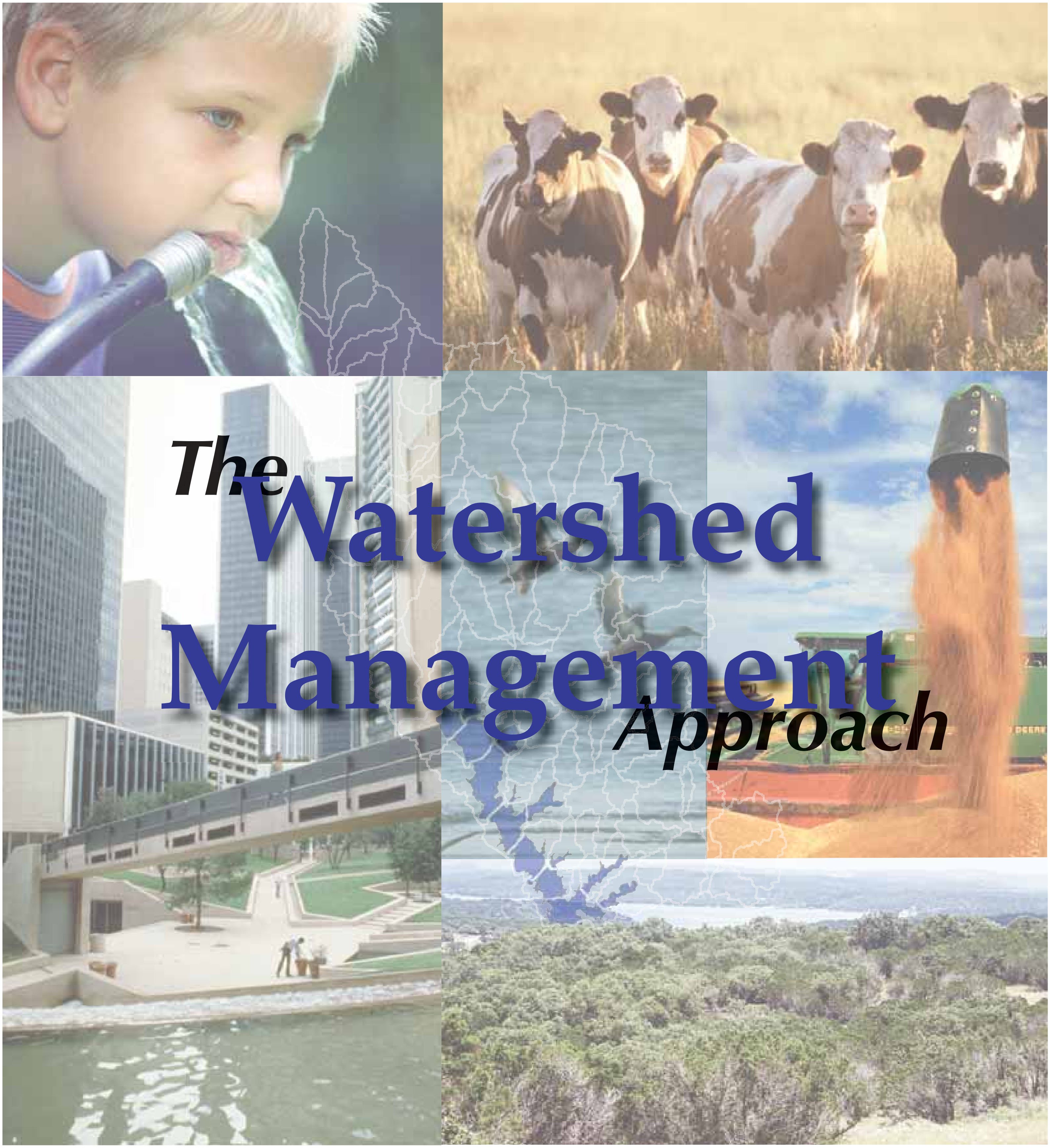
The Watershed Management Approach



The Watershed Management Approach

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What is a watershed?

A watershed is the land area that drains into a common water body (e.g. stream, pond, lake, etc.); the watershed for a major river can encompass smaller watersheds that ultimately combine at a common point. A watershed includes all surface water and groundwater, soils, vegetation and animals, and human activities contained within its area.

Texas has more than 191,000 miles of rivers and almost 2 million acres of lakes. Wherever you live and whatever you do, you are in a watershed, so you contribute to the quantity and quality of the water that enters Texas' lakes and streams.

What is the watershed management approach?

The United States Environmental Protection Agency (U.S. EPA) has endorsed the watershed management approach, which is defined as a coordinated environmental management framework that focuses public and private efforts on a watershed's highest-priority problems. In the past, such an approach was used more commonly in polluted watersheds or those with limited water supplies, but it also can be proactive, preventing such problems from occurring.

Although large watersheds are usually managed by the local, state or federal government, landowners throughout an area will benefit by becoming familiar with the watershed management cycle. The approach includes five steps: planning, collecting data, assessing current water quality and targeting desired standards, developing goals and strategies to reach those standards, and putting those strategies into practice and measuring their effectiveness. (Figure 1 graphically outlines this process.)

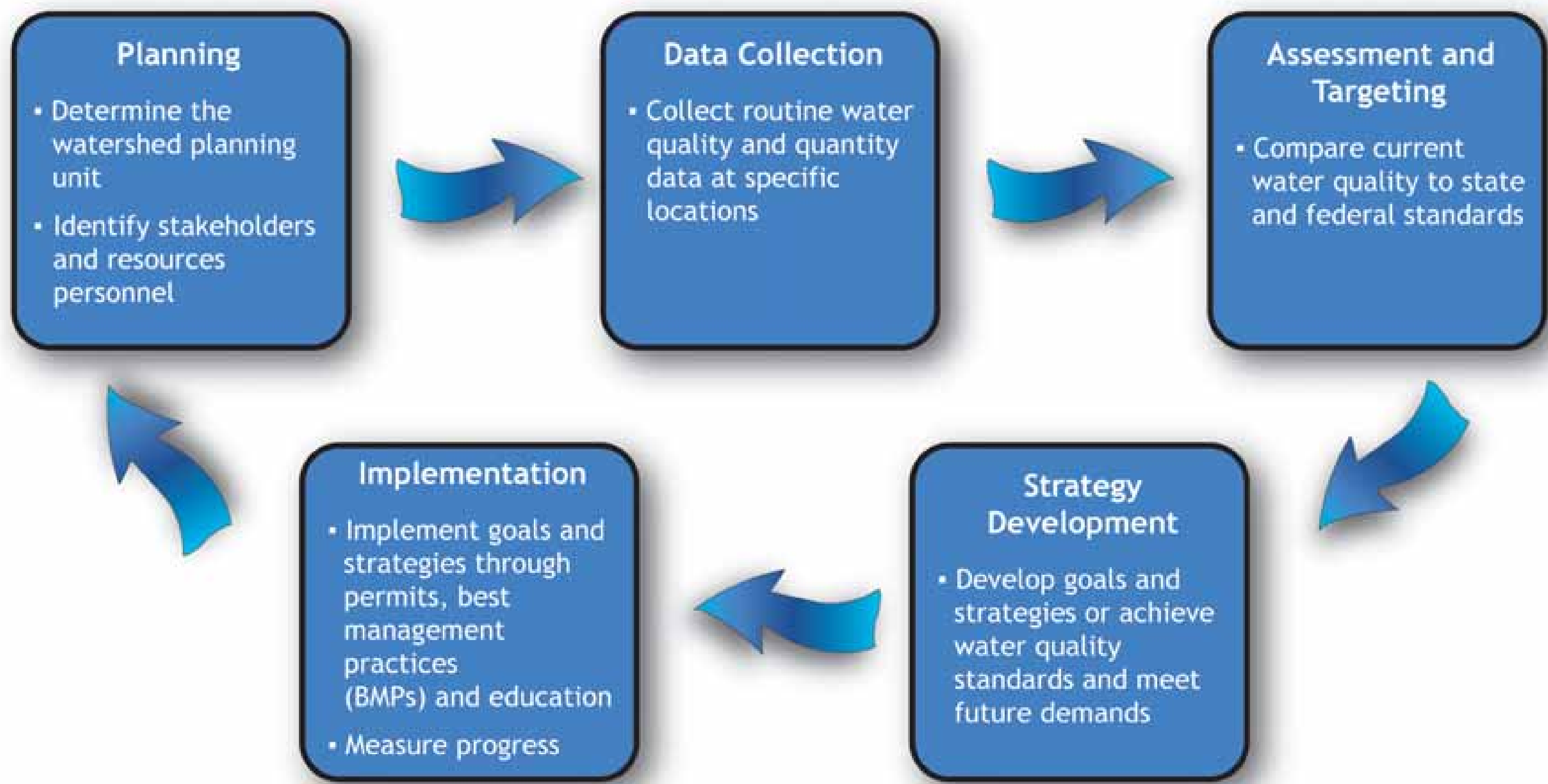

Figure 1: The watershed management cycle.

Planning

Determine the watershed planning unit and
Identify stakeholders and resource personnel

Determining the watershed planning unit

Watershed units vary from mainline portions of large river basins to small areas discharging excess flows into ponds. Watershed size influences stakeholder roles in all steps of the watershed management cycle.

Although watershed units are usually based on geographic boundaries, they also may be defined according to which government unit exercises authority over a particular land area. For example, a state or federal agency may be the lead stakeholder in a large river basin (1,000 to 10,000 square miles), but local government agencies may play the larger role in a subwatershed (1 to 10 square miles). Watershed unit size also generally determines (1) influence of impervious ground cover due to urban growth and (2) management focus from site-specific design to planning for the entire river basin (see Table 1).

Texas' extensive surface water network consists of 23 major river basins, which may be confined within the state or shared with neighboring states or along an international border (see Figure 2). This extensive river network helps Texans meet their water needs. However, Texas surface water quality varies because of both natural processes and human activities. The state of Texas also monitors and manages the Gulf of Mexico.

Want to find your watershed?
See the Environmental Protection Agency (EPA) Web Site "Surf Your Watershed" at http://www.epa.gov/surf/.

Identifying stakeholders and resource personnel

Successful watershed management needs local support and so demands a mixture of stakeholders representing an area's population. Direct stakeholders live within a watershed and influence water quality, while indirect stakeholders live outside the watershed boundaries but may use its water.

Resource individuals or groups bring technical expertise to stakeholders and decision makers. Such personnel can include scientists, engineers, conservationists, policy experts and attorneys and may be either contractors or stakeholders themselves.

Who are stakeholders in my watershed?
Although every watershed is unique, examples of stakeholders include:

- Landowners (permanent and absentee)
- Homeowners
- Local businesses
- Agricultural producers
- Industries
- City and county officials
- Water and wastewater utilities
- Environmental activists
- Conservationists
- Civic groups

Table 1: Watershed Management Unit Characteristics (Schueler, 1995)

Watershed Management Unit	Typical Area, Square miles (Acres)	Influence of Impervious Cover	Primary Planning Authority	Management Focus
Catchment	0.05-0.50 (32-320)	Very strong	Property owner (local)	Best Management practices and site design
Subwatershed	1-10 (640-6,400)	Strong	Local government	Stream classification and management
Watershed	10-100 (6,400-64,000)	Moderate	Local (or multi-local)	Watershed-based zoning
Subbasin	100-1,000 (64,000-640,000)	Weak	Local, regional or state	Basin planning
Basin	1,000-10,000 (640,000-6,400,000)	Very Weak	State, multi-state or federal governments	Basin planning

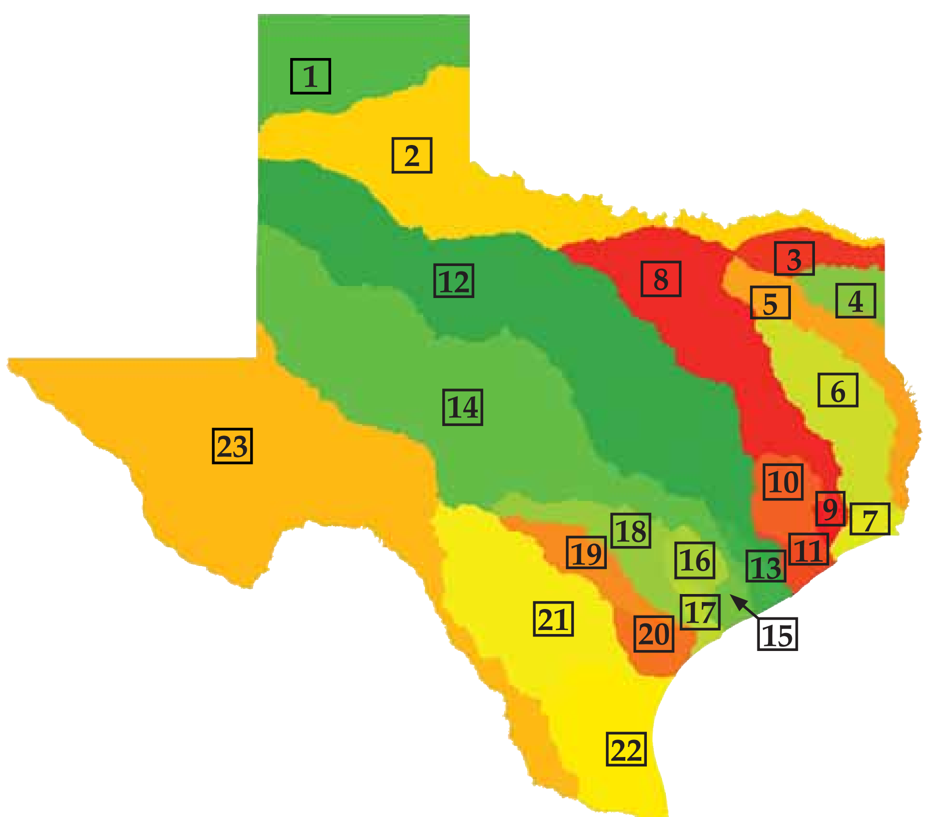

Figure 2: Texas river basins.

Water Management Size Categories

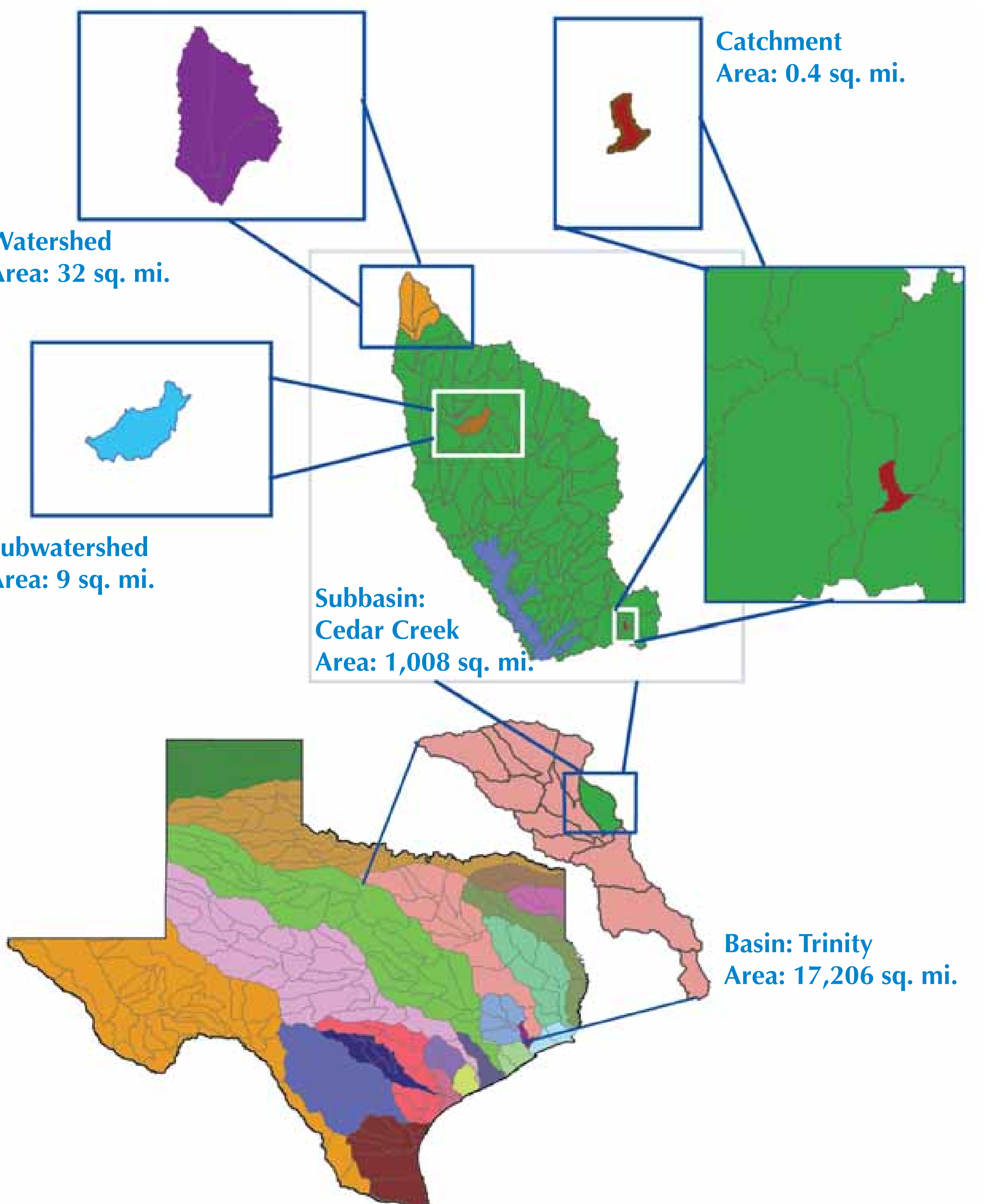

Figure 3: Water management size categories.

Data Collection

Collect routine water quality
and quantity data at specific locations

Degrading water quality may trigger development of a watershed management plan. The resulting water quality analysis will focus on point source and nonpoint source pollutants, with total pollutant load given by the formula:

Total Pollutant Load = Total Point Source Load + Total Nonpoint Source Load

Point Source Pollution

Point source pollution results from collection of pollutants and their discharge at a defined point. Examples of point sources include:

- Wastewater treatment discharges
- Industrial waste discharges
- Stormwater collection systems

State and federal environmental agencies typically monitor and regulate point sources, based on quality and quantity standards. Using tougher standards at point sources may be expensive, but it can be easier because pollutants are delivered to just one area for treatment.

Nonpoint Source Pollution

Nonpoint source pollution comes from sources that are spread out across the landscape, and such pollutants are generally hard to collect and treat. The U.S. EPA lists sediments and nutrients as the most common nonpoint source pollutants. Other examples include:

- Excess fertilizers, herbicides and insecticides from agricultural lands and residential areas
- Oil, grease and toxic chemicals from urban run-off and energy production
- Sediment from improperly managed construction sites, crop and forest lands, and eroding streambanks
- Salt from irrigation practices
- Acid drainage from abandoned mines
- Bacteria and nutrients from livestock, pet wastes and faulty septic systems
- Atmospheric deposition
- Hydromodification such as channel modification and dams

Depending on its nature, nonpoint source pollution may be controlled through the design, construction and maintenance of best management practices.

What information about the watershed might be useful to gather? (Reimold, 1998)

- Sizes, locations, and designated uses of all water bodies
- Any impairments to a water body's use supports
- Causes of impairment, such as pollutants and habitat limits
- Water quality attributes: physical, biological, chemical
- Categories of nonpoint sources and estimates of their loadings
- Groundwater quality and sources affecting it
- Fish and wildlife surveys
- Maps: topographic, hydrologic, land use/cover (wetlands, riparian areas)
- Detailed soil surveys
- Demographic data and growth projections
- Economic conditions, such as income and employment
- Threatened and endangered species and their habitat
- List of relevant local stakeholders

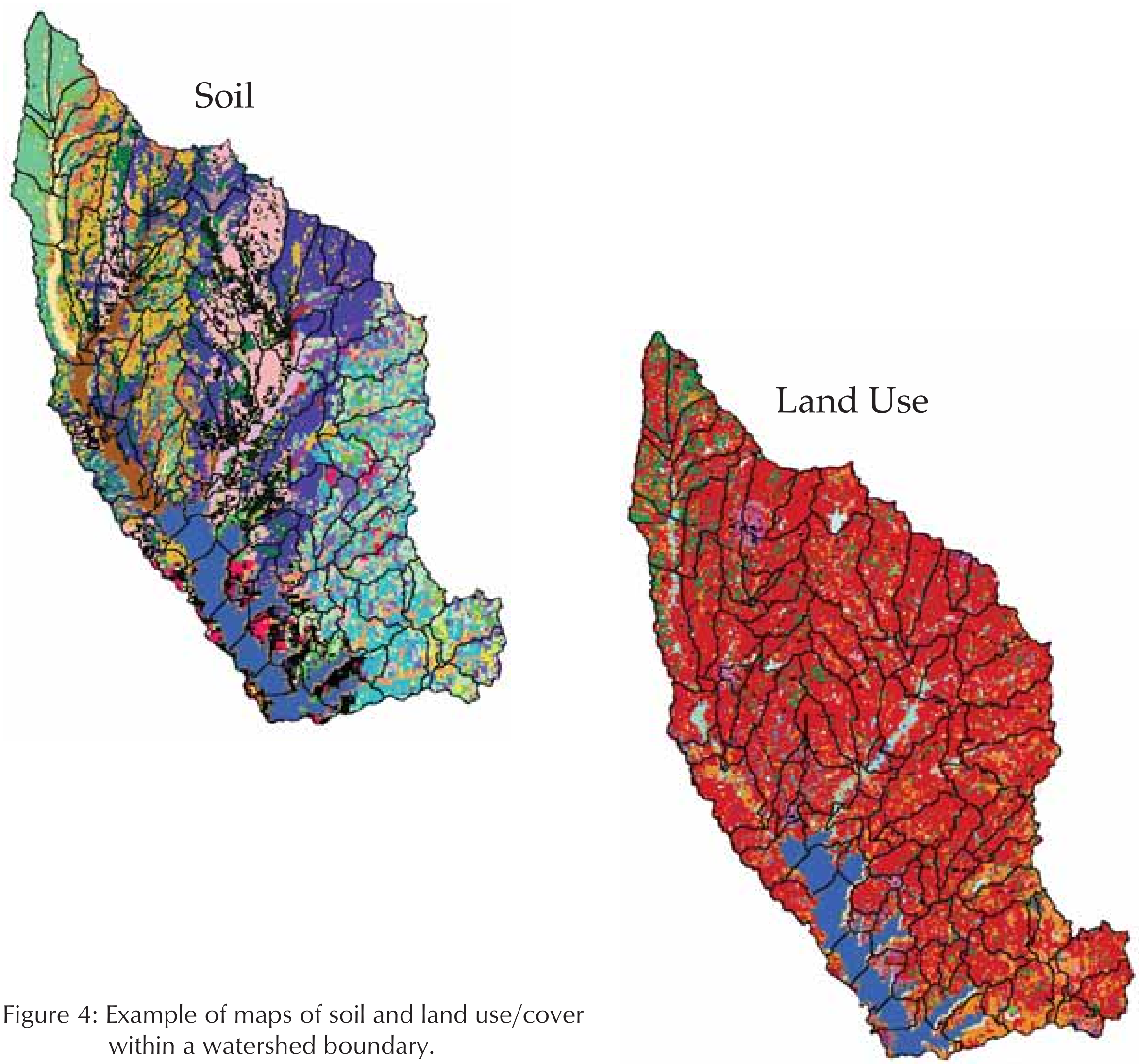

Figure 4: Example of maps of soil and land use/cover within a watershed boundary.

Who might monitor water quantity and quality in my watershed?

- Groundwater conservation districts
- Municipal utility districts
- Regional planning groups
- River authorities
- Texas Commission on Environmental Quality
- Texas Parks and Wildlife
- Texas Water Development Board
- United States Army Corps of Engineers
- United States Environmental Protection Agency
- United States Fish and Wildlife Service
- United States Geological Survey

Assessment and Targeting

Compare the current water quality to state and federal standards

Federal and state agencies have expressed increasing concern about water quality and continue to develop methods to evaluate it. For example, the Texas Surface Water Quality Standards (Title 30, Chapter 307, Texas Administrative Code) are designed to:

- establish numerical and narrative goals for water quality; and
- provide a basis for the Texas Commission on Environmental Quality (TCEQ) to develop reasonable methods for reaching these goals.

Such protective government standards signal situations in which water quality may be inadequate for designated uses. For example, a water body with no observed fish kills nonetheless might fail to meet aquatic-life use standards, as evidenced by a decline in the variety or number of aquatic species.

The Texas Surface Water Quality Standards defines four general categories for water use: aquatic life use, contact recreation, public water supply and fish consumption.

Aquatic Life Use

These standards protect plant and animal species living in and around the water by setting optimal aquatic-life support conditions and defining indicators for these conditions. Low dissolved-oxygen levels or presence of toxic metals or pesticides may violate this standard.

Contact Recreation

This standard measures bacteria levels to estimate relative risks from swimming or other water sports involving direct contact with the water. While water not meeting this standard may not make swimmers sick, their probability of illness rises with increasing bacteria levels.

Public Water Supply

These standards, which include screening for toxic metals and pesticides, indicate whether a lake or river can be used to supply public drinking water. (A separate set of standards governs treated drinking water.) Drinking water standards also measure concentrations of salts such as sulfates or chlorides, because treatment to remove them is expensive.

Fish Consumption

These standards protect the public from eating contaminated fish or shellfish by identifying risks of accumulation of toxic materials or bacteria in aquatic species. Because these predictions are not always accurate, the state also tests fish and shellfish caught in state waters to determine that they are safe for commercial harvest, sale and public consumption.

Identifying Impaired Waters

Every 2 years, Texas conducts a Surface Water Quality Inventory to identify impaired water bodies (known as the 303(d) list) and to establish Total Maximum Daily Load (TMDL) programs for bodies of water exceeding state standards for a particular contaminant.

What is the Surface Water Quality Inventory and the 303(d) list?

The Surface Water Quality Inventory describes the quality of Texas' waters based on historical surface water and groundwater data. The 303(d) list identifies water bodies not meeting use standards. These reports satisfy federal Clean Water Act requirements for Sections 305(b) (water quality reports) and 303(d) (lists). As required by law, Texas produces these reports every 2 years in even-numbered years. The EPA must approve the list before it is considered final.

What is a TMDL?

The Total Maximum Daily Load (TMDL) program seeks to restore rivers, lakes and bays with substandard water quality. A "budget for pollution," the TMDL uses a scientific model to:

- determine the maximum amount of a pollutant at which a lake, river or estuary can attain and maintain its use standards; and
- assign this load amount to point and nonpoint sources in the watershed.

An implementation plan puts the TMDL into action by outlining regulatory and voluntary steps necessary to reduce pollutant loads.

Am I in a TMDL?

To determine whether you are in a TMDL, first identify your watershed. Then, check whether the current 303(d) list includes your watershed and its associated water quality parameter.

Do I contribute to a TMDL in my area?

All activities, whether agricultural, industrial, municipal or recreational, contribute to the water quality of your watershed. However, depending on the nature of the pollutants involved, some activities may contribute more than others.

How is a TMDL designation removed?

A plan to manage your watershed's TMDL must be developed and effectively used before your watershed can be removed from the 303(d) list of impaired water bodies.

(Surface Water Quality Inventory and TMDL information adapted from the TCEQ Web site)

Strategy Development

Develop goals and strategies to maintain or achieve water quality standards and meet future demands

By helping to set goals and to assign priorities to them, direct and indirect stakeholders play a key role in identifying strategies and in designing watershed management plans. Plan development also should involve interest groups, experts (such as private or public engineers and scientists) and policy makers (such as local, regional, state and federal planning personnel). Seeking input from such a wide range of concerned persons will produce management plan decisions that include policy and practical implications.

Management plans that outline specific goals produce the best results for stakeholders. For example, instead of setting a goal to "improve water quality," decide to reduce watershed phosphorus loading by 25 percent or to develop a computer model that accurately predicts nitrogen and phosphorus loadings for a particular lake.

What are water quality models?

Water quality models use personal computers and mathematics to represent natural watershed processes. Water quality models allow managers, engineers and planners to develop and evaluate "what-if" scenarios. Such models generally need information on topography, land use, climate and soils. They can assist stakeholders in evaluating the effect on the watershed of management strategies and land use changes. But models' usefulness is limited by the size of the watershed (scale) and by the data available (such as stream flow and water quality parameters). And successful results depend on combining models with considerations about the social acceptability of suggested water quality solutions.

Implementation

Implement goals and strategies through permits, best management practices, and education and measure progress

To fit their watershed's needs, stakeholders and decision makers may customize the tools that exist for putting watershed management plans into practice. Three of those tools are permits, best management practices (BMPs) and educational programming. Each watershed management plan will have site-specific needs requiring different combinations of these three tools.

Permits

Regulatory permits are used most often to control point sources. Such permits are issued by the government and specify discharge levels for pollutants. Point sources may not exceed these permitted levels. Point source contributors might address water quality issues by making existing permits more stringent. However, putting such permit changes into practice may require facility expansion and new processes that will increase treatment costs for a facility's users or consumers. A watershed management approach that uses permits as its sole tool will be effective only if point sources are the dominant contributors to water quality problems.

BMPs

BMPs are the preferred approach to managing nonpoint source pollution. Although BMPs are often voluntary, some regulatory agencies require their inclusion in watershed management plans. For example, the National Pollutant Discharge Elimination System (NPDES) combines construction permits with BMPs for erosion and runoff control. A watershed management strategy that uses BMPs as its sole tool will be effective only if nonpoint sources are the dominant contributors to water quality problems.

Educational Programming

Education is key to a successful watershed management plan. Education programs can alert stakeholders to watershed problems and can help involve them in decision making. Educational programs also draw the attention of both agency employees and stakeholders to the need for a proper strategic balance between permits and BMPs. Such balance leads to management plans that address pollution from both point and nonpoint sources.

What is the major permitting program in place?

As authorized by the Clean Water Act, the permit program of the National Pollutant Discharge Elimination System (NPDES) controls water quality by regulating point-source pollution, including discharges into United States waters by concentrated animal feeding operations (CAFOs), combined sewer overflows (CSOs), pretreatment (wastewater treatment) plants, sanitary sewer overflows (SSOs) and stormwater (construction activities, industrial activities and municipal stormwater sewers).

What are some examples of best management practices?

- Vegetated filter strips
- Wet ponds
- Grassy swales
- Nutrient management
- Changes in land use or management
- Wetlands
- Filtration basins
- Conservation tillage
- Septic system maintenance
- Streambank stabilization

What types of educational programming can be useful?

- Publications
- Field days
- Demonstration projects
- Tours
- Focus groups
- Media coverage
- Newsletters
- Surveys

Measuring progress

The watershed management approach can be put into practice successfully only if progress on the adopted watershed management plan can be measured. For example, if a plan's goal is to reduce lake phosphorus concentrations by 25 percent, ongoing monitoring should assess concentration trends over time. Such monitoring will help determine whether plan strategies (permits, BMPs, education) are achieving desired outcomes.

Repeating the Cycle

The watershed management approach can be used to decide when (and what) actions are needed either to correct water quality or quantity problems (reactive mode) or to prevent such problems (proactive mode). Because watersheds and watershed management tools are dynamic, the steps outlined in Figure 1 must be repeated continually to make sure that sound decisions are ongoing.

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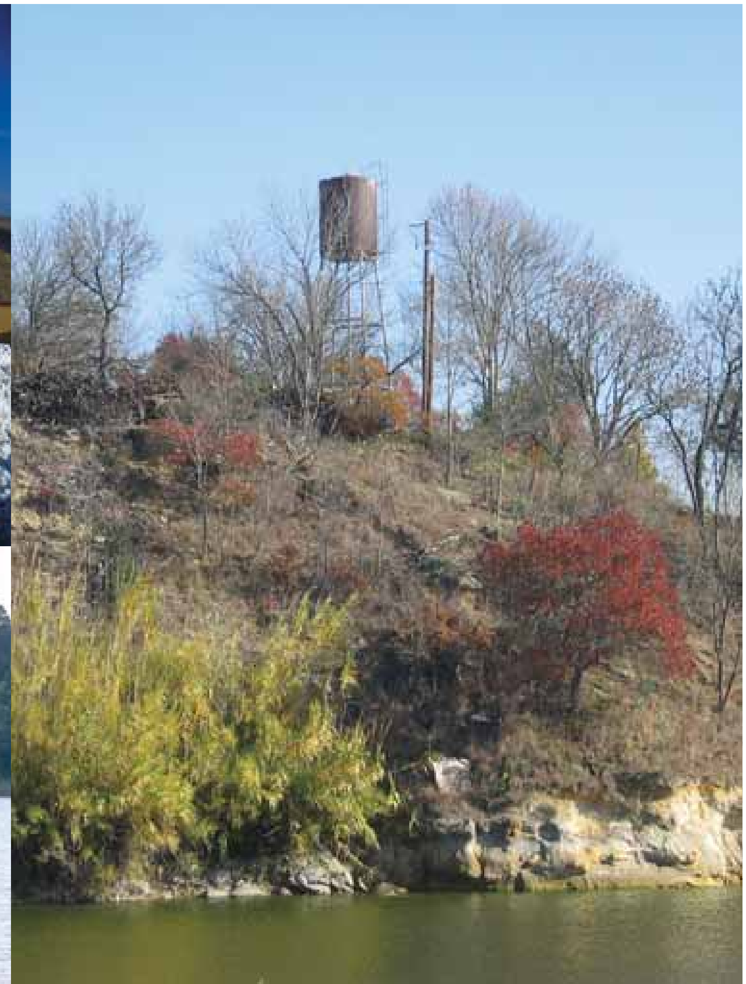

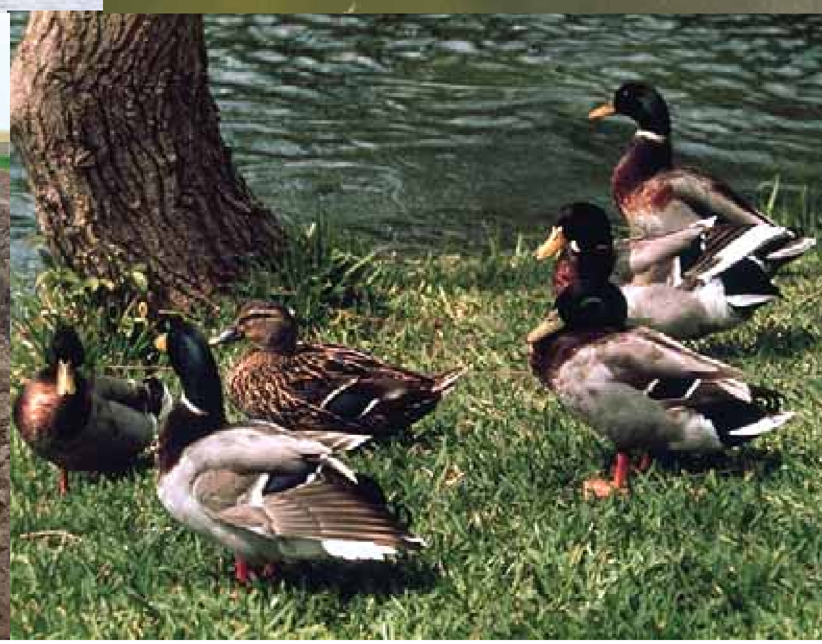

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